DOCTOR OF PHILOSOPHY
IN
MECHANICAL ENGINEERING

DEFORMATION BANDING AND GRAIN REFINEMENT IN FCC MATERIALS

Douglas L. Swisher-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1993
M.S., Naval Postgraduate School, 2000
Doctor of Philosophy in Mechanical Engineering-March 2003
Advisor: Terry R. McNelley, Department of Mechanical Engineering

Microscopy methods in scanning and transmission electron microscopes have been employed to assess microstructures developed by deformation processing of selected face centered cubic (FCC) materials. Grain maps constructed from orientation data and analysis of transmission data illustrate the presence of fine grains and deformation bands in which the lattice orientation contains symmetric variants of a texture component. A banded, deformation microstructure is present to various degrees in FCC material systems irrespective of processing and material composition. The specific components of the deformation bands were observed to vary depending upon processing conditions of the material and the specific material. Single component and entire deformation textures from shear and plane strain, were both observed. The high-angle (40˚-62.8˚) interfaces or boundaries in the microstructure evolve from the interfaces between the bands while the lower-angle (2˚-15˚) boundaries tend to separate cells within the bands. Models of microstructural development that include deformation banding during cold working may be employed to describe both texture development and the origin of the high-angle grain boundaries.

KEYWORDS: Grain Refinement, Ultra-fine Grains, Deformation Banding, Plastic Deformation, Severe Plastic Deformation, Misorientation Angle, Orientation Imaging Microscopy, Electron Backscatter Diffraction, Equal-Channel Angular Pressing, Supral 2004, Nano Structures, Transmission Electron Microscopy

DOCTOR OF PHILOSOPHY
IN
METEOROLOGY

THE CALIFORNIA COASTAL JET: SYNOPTIC CONTROLS AND TOPOGRAPHICALLY INDUCED MESOSCALE STRUCTURE

Patrick S. Cross-Lieutenant Commander, United States Navy
B.S., New Mexico Institute of Mining and Technology, 1982
M.S., Naval Postgraduate School, 1993
Doctor of Philosophy in Meteorology-March 2003
Dissertation Supervisor: Wendell Nuss, Department of Meteorology

The low-level jet along the coast of southern Oregon and California is examined in detail through an extensive data set and the application of COAMPS, a mesoscale model, for the purpose of improving forecasts in challenging littoral environments. The jet forms within the broad equatorward flow established by the pressure gradient between cool ocean and warm land. The inception of the jet along the coast is about 250 kilometers south of the axis of a northeastward extension of the eastern North Pacific high, and the jet may extend equatorward and offshore for hundreds of kilometers. Wind magnitudes increase in association with a reorientation of the coastal surface pressure gradient such that an increased down-coast component exists. Within 200 kilometers of the coast, considerable diurnal and spatial variability are observed and predicted by the model. The frequently observed low-level high wind areas at specific locations along the coast are caused by the combined effects of supercritical expansion within the boundary layer and mountain wave-type flow above the marine layer over six coastal mountain areas in close proximity to the coast. While the expansion fan effects are localized near a coastal bend, it is the offshore extension of the mountain wave that accounts for the large spatial extent of the maximum wind areas offshore.

KEYWORDS: Coastal jet, Low-level Winds, Marine Boundary Layer, Mountain Wave, Supercritical Flow, COAMPS, Mesoscale Modeling, Lee-side Wind Maxima, Topographic Effects, Orographic Effects, Expansion Fans, Coastal Meteorology, Littoral Meteorology, Marine Environment

DOCTOR OF PHILOSOPHY
IN
PHYSICAL OCEANOGRAPHY

SENSITIVITY STUDIES USING MULTI-REGION AND OPEN BOUNDARY CONDITIONS FOR TERRAIN BOTTOM-FOLLOWING OCEAN MODELS

Antonio S. Martinho-Lieutenant, Portuguese Navy
B.S., Portuguese Naval Academy, 1992
M.S., Naval Postgraduate School, 2001
Doctor of Philosophy in Physical Oceanography-March 2003
Dissertation Supervisor: Mary Batteen, Department of Oceanography
Committee Members: A. J. Semtner, Department of Oceanography
J. McClean, Department of Oceanography
R.T. Williams, Department of Meteorology
J. Pullen, Naval Research Laboratory

The objective of this thesis is to develop a prognostic model of the Northern Canary Current System (NCCS), based on the Princeton Ocean Model, with parallel processing capabilities on a cluster of workstations and improved boundary conditions. A one-way coupling with a z-level basin scale model, a North Atlantic version of the Parallel Ocean Program, will also be executed. The development of this model will allow the investigation of coastal processes and the development of numerical models in order to improve the results of sigma coordinate bottom-following ocean models. The roles of wind forcing, bottom topography, and thermohaline gradients in coastal processes will be investigated. In order to reduce the Pressure Gradient Force Error while maintaining a realistic topography, a new topographic smoothing technique will be developed. Modified Marchesiello boundary conditions will be applied to a version of POM model one-way coupled with a North Atlantic version of POP. Finally, an automatic multi-region parallelization will be developed, applying minimal changes to the serial POM code. It is shown that a prognostic sigma-coordinate model can be successfully developed for the NCCS, with more realistic topography, improved boundary conditions, and with parallel processing capabilities.

KEYWORDS: Sigma Coordinate Model, Parallelization, MPI, Boundary Conditions, Multi-region